SharpEye™

UV/IR Flame Detector

Model 20/20L-LB

User's and Maintenance Manual

TM20/20LB Rev E, August 2004

Factory Mutual Approved
Class I Div. 1 Groups B, C, D
Class II Div. 1 Groups E, F, G

ATEX Approved
Ex II 2G
EExd IIB + H_2 T5
EExde IIB + H_2 T5

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Warning:

This manual should be carefully read by all individuals who have or will have responsibility for using, maintaining or servicing the product.

The Detector is not field-repairable due to the meticulous alignment and calibration of the sensors and the respective circuits. Do not attempt to modify or repair the internal circuits or change their settings, as this will impair the system's performance and void the Spectrex, Inc. Product warranty.

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1. Scope

1.1 Product Overview

The Spectrex Model 20/20L, 20/20LB is a UV-IR Flame Detector. It is designed to sense the occurrence of fire and flames and subsequently activate an alarm or an extinguishing system directly or through a control circuit for maximum fire protection. It uses innovative technology of advanced digital signal processing to analyze the dynamic characteristics of fire.

The difference between the Models is that Model 20/20LB includes a Built In Test (BIT) function while the model 20/20L does not.

Detection performance is controlled by a microprocessor and easily adapted to all environments, applications and requirements. The result is a unique and superior flame detector that provides excellent detection sensitivity with extreme immunity to false alarm.

1.2 Document Overview

This manual describes the detector and its features. It describes instructions on the installation, operation and maintenance.
This manual is divided into several parts. Each part is contained in a separate chapter as follows:

Chapter 1. **Scope**. A general introduction and overview of the product and the Manual with a brief description of its content.
Chapter 2. **Technical Description** - the detector's theory of operation.
Chapter 3. **Performance -** the detector features and capabilities.
Chapter 4. **Operation** modes, user interface and indications.
Chapter 5. **Technical Specifications** Detector's electrical, mechanical and environmental specifications.
Chapter 6. **Installation Instructions** including wiring and mode setting.
Chapter 7. **Operating Instructions** and power-up procedures.
Chapter 8. **Maintenance Instructions** and support procedures.
Appendix A. **Wiring Selection Tables** for electrical wire selection according to installation configuration.
Appendix B. **Typical Wiring Configurations** provides wiring diagrams for installation.
Appendix C. **Mounting the "EExde approved" version**
Appendix D. **Long Range UV/IR Fire Simulator**

2. Technical Description

- **Detection Range**: Up to 50 ft (15m) for a 1ft x 1ft (0.3m x 0.3m) Gasoline fire.
- **Ultra High Immunity to False Alarm** (see section. 3.3.).
- **Advanced Digital Processing of the Dynamic Characteristics of Fire:** Flickering and threshold
- **Dual Spectrum**: UV and IR radiation
- **Multiple Detection Levels**: Warning, alarm and saturated signal
- **Solar Blind**
- **Microprocessor Based**: Microcontroller performs signal processing
- **Built-In-Test**: Manual and automatic BIT for 20/20LB only (see section 4.5)
- **Electrical Interface**:
    - Dry contact RELAYS.
    - 4-20mA outputs.

2.1 Principles Of Operation

The Model 20/20L, 20/20LB Radiation Flame Detector is an electronic device designed to sense the occurrence of fire and flames and subsequently activate an alarm or an extinguishing system directly or through a control circuit.

The UV-IR Radiation Flame Detector is a dual spectrum optical detector sensitive to two separate ranges of the radiation spectrum, both of which are present in fires. The detector monitors the protected volume, by measuring the radiation intensity in it, within two frequencies ranges of the electromagnetic spectrum, namely the Ultra-Violet (UV) and the Infra-Red (IR).

The detector integrates two dependent channels in which appropriate detection pulses are registered and further analyzed for frequency, intensity and duration.

2.2 Sensing Elements

The IR sensor is sensitive to radiation over the range of 2.5-3.0 micron. The IR channel will register a detection signal, at the appropriate level, when the IR sensor is exposed to radiation in the appropriate frequency range, having an intermittent gleam pattern characteristic to flickering-fire, and a preset threshold and time duration are reached.

The UV sensor is sensitive to radiation over the range of 0.185-0.260 micron. The UV channel incorporates a special logic circuit that eliminates false alarms caused by solar radiation and other non-fire UV sources. Further more; the UV channel sensitivity is stabilized over the working temperature range.

2.3 Detection Levels

Simultaneous detection of radiation in both the UV and the IR channels having an intensity, which exceeds detector's preset Warning level, will result in a Warning signal.

In addition, the detector includes an option that detection of UV radiation at high intensity will result in a Warning Signal.

Simultaneous detection of radiation in both the UV and the IR channels having an intensity, which exceeds detector's preset Alarm level, will result in an Alarm signal.

Simultaneous detection of radiation in both the UV and the IR channels having an intensity which exceeds detector's preset Flash-Fire Detection level will result in an immediate Alarm signal, regardless of the detector mode setting selected.

Since the preset dual range and level of radiation, as well as the flickering pattern, are characteristic of real fire, all other radiation sources apart from actual fire will not be detected, thus avoiding false alarms.

2.4 Alarm Signal Delay

The detector is adapted with an Alarm Signal delay selector, allowing the user to set a different delay between 0 to 30 seconds, mandatory for several specific applications.

When Alarm level detection conditions are met, an internal time delay is initiated as preset on the selector. Once the preset time delay has elapsed, detection conditions are evaluated for 3 seconds. If during that evaluation period Alarm level detection conditions persist, the Alarm signal is triggered. If no Alarm level detection conditions endure, the Alarm signal Delay is reset.

2.5 Built-In-Test (BIT) Capabilities

The detector (only 20/20LB) is adapted with Built-In-Test (BIT) capabilities. The BIT is continuously performs at predetermined time intervals averaging 60 minutes. It performs automatic full-featured test of the detector's internal electric circuits, and checks the radiation sensors and the detector window's cleanliness.

The BIT circuits will generate response signals to indicate satisfactory operation of the detector or a fault should it be detected during a BIT sequence. The BIT sequence can also be initiated manually by the user at his preference, upon a remote operation from a control unit.

2.6 Detector Structure

Figure 1 presents an outline drawing of the Flame Detector Assembly.
Figure 2 presents a schematic section of the internal Flame Detector, and describes its main components.

2.7 System Configuration

The Spectrex model 20/20L, 20/20LB is a self-contained Optical Flame Detector that can function as a stand alone unit directly connected to external devices as alarm systems or automatic fire extinguishing systems. The same detector can form part of a more complex system where a plurality of detectors and other devices are integrated through a dedicated control unit.

2.8 Detector Types

This manual covers two types of detectors. Model 20/20LB and model 20/20L, the difference is that Model 20/20LB includes a BIT and 20/20L does not include this feature.

Both models are available in either Aluminum (Al.) housing, or Stainless Steel (St.St.) housing.

There is an option for higher ambient temperature 185°F (+85°C) version if specified.

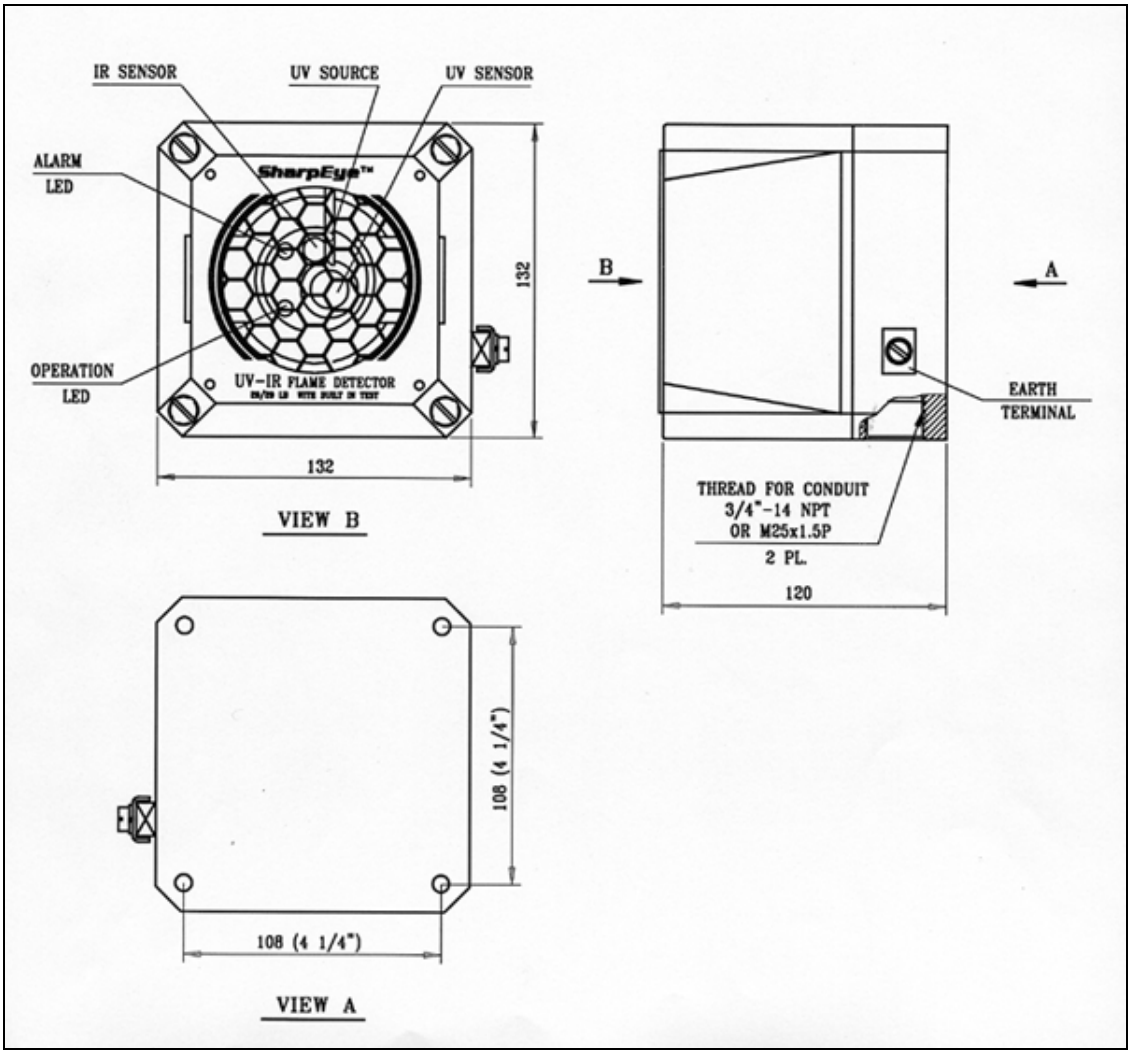


Figure 1. Flame Detector Assembly - Outline Drawing

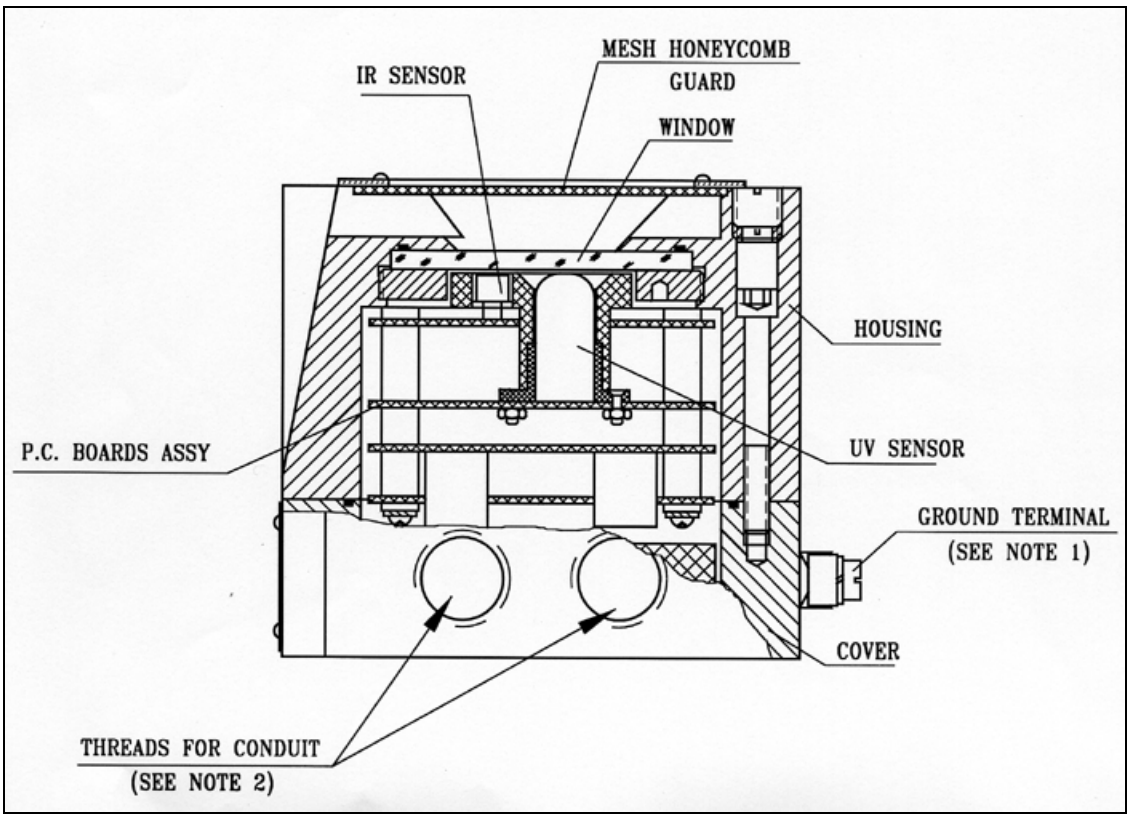


Figure 2. Flame Detector Assembly - Schematic Section

Note 1: This figure describes the Detector, which includes Ground Terminal for ATEX installation. For FM installation device, which includes 1/4" thread for external grounding screw mounting.

Note 2: Conduit/cable entries - standard size is 3/4"-14NPT or M25 as specified at time of order

3. Performance

3.1 Detection Sensitivity

Detection sensitivity is the maximum distance at which the detector will reliably detect a specific size of fire & typical type of fuel (standard fire).

Standard Fire:
Standard fire is defined as a 1ft x 1ft (0.3m x 0.3m) Gasoline pan fire with max. Wind speed of 6.5ft/sec (2m/sec).

Sensitivity Ranges:
The detector has three response levels:

1. Warning (Pre-alarm)
2. Alarm
3. Saturated Signal

For some typical ambient conditions the Zeta parameter as defined in NFPA 72 for the detector is 0.01 (1/meter).

Note:
Zeta parameters may vary significantly with changes in temp, air pressure, humidity, visibility conditions, etc.

Response Time:
The typical response time of the detector is 3 seconds for 1 sq. ft. gasoline fire, and 20 msecs for saturated signal, which is defined as a 5” diameter Gasoline fire from a distance of 12”.

Other Fuels:
The Detector will react to other fuels in standard fire conditions at maximum response time of 3 seconds.

The sensitivity range to other fuels varies according to the fuel type. Table 1 below provides the sensitivity to other fuels relative to (as a percentage of) the sensitivity to a standard gasoline fire source.

Table 1. Response Sensitivity Ranges

Type of Fuel	% of Max. Distance at Each Sensitivity Range
Gasoline	100%
N-Heptane	100%
Alcohol 95%	75%
JP4	75%
Kerosene	75%
Diesel Fuel	75%
Methane Fire*	30%
Propane Fire*	30%

** 0.5m plume fire*

3.2 Cone Of Vision

Horizontal: 90°
Vertical: 90°

Figure 3 illustrates the relative range as a function of the incidence angle.

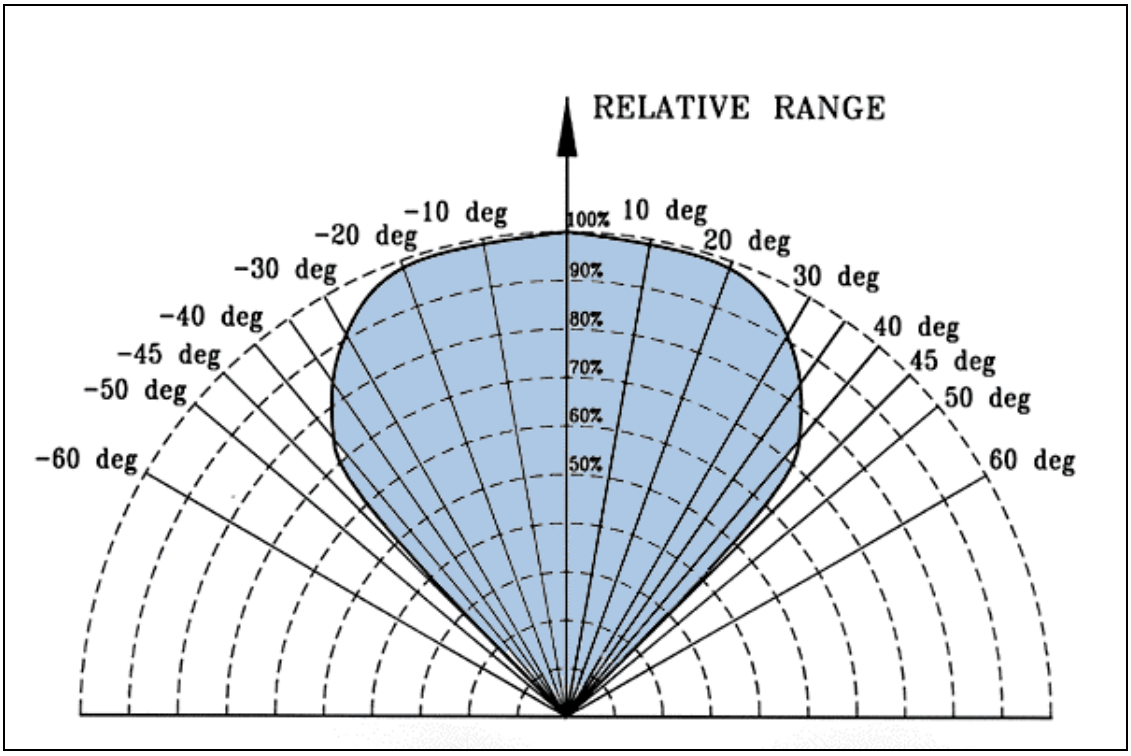


Figure 3. Horizontal and Vertical Fields of View

3.3 False Alarms

The detector does not provide an alarm or a warning signal as a reaction to the radiation sources specified at Table 2 below.

Notes:
IAD = Immune at any distance.
All sources are chopped from 0 to 20 Hz.

Table 2. Immunity to False Alarm Faults

Radiation Source	Immunity Distance ft. (m)
Sunlight	IAD
Indirect or reflected sunlight	IAD
Vehicle headlights (low beam) conforming to MS53023-1	IAD
Incandescent frosted glass light, 100W	IAD
Incandescent clear glass light, rough service, 100W	IAD
Fluorescent light with white enamel reflector, standard office or shop, 40W (or two 20W)	IAD
Arc welding [4mm (5/32in) rod; 240A]	9.8ft (3m)
Bright colored clothing, including red and safety orange	IAD
Electronic flash (180 watt seconds minimum output)	IAD
Red dome light conforming to M251073-1	IAD
Blue-green dome light conforming to M251073-1	IAD
Flashlight (Mx 991/U)	IAD
Radiation heater, 1500W	IAD
Radiation heater, 1000W with fan	IAD
Grinding metal	3.3ft (1m)
Lit cigar or cigarette	IAD
Match, wood, stick including flare up	3.3ft (1m)

4. Operation

4.1 Visual Indications

Two indication LEDs are located in the detector's front window.

Yellow LED - Provides indication of Normal or Fault state.
Red LED - Provides indication of Warning or Alarm state.

Table 3. LED indications within different detector states

Detector State	Yellow LED	Red LED
Normal	Blink at 0.5Hz Rate	Off
Fault or BIT Fault	Blink at 2Hz Rate	Off
Warning	Blink at 0.5Hz Rate	Blink at 2Hz Rate
Alarm	Blink at 0.5Hz Rate	On
Warning at BIT Fault	Blink at 2Hz Rate	Blink at 2Hz Rate
Alarm at BIT Fault	Blink at 2Hz Rate	On

4.2 Output Signals

The detector includes the following control outputs:

- Alarm Relay
- Accessory Relay
- Fault Relay
- 4-20mA Current Source Output

4.3 Mode Selection

The detector has 2 DIPswitches, which enables the user to adapt the detector's operation to specific applications:

- Function switch (SW1)
- Alarm Delay Switch (SW2)

4.3.1 Function switch (SW1)

The user can select the desired mode of operation by means of this switch according to Table 4.

Table 4. Function Switch SW1

SW	ON Position	OFF Position
1	Alarm Signal Latching enabled. Reset of the Alarm signal is performed by momentary disconnection of power supply or manual BIT activation.	Alarm Signal Latching disabled **(default).**
2	Automatic & Manual BIT can be performed **(default)**.	Only Manual BIT can be performed.
3	High UV protection enabled.	High UV protection disabled **(default)**.
4	Accessory Relay used by the Warning level.	Accessory Relay used in parallel to the Alarm Relay **(default)**.
5	Warning conditions: UV & IR at Warning level, or UV at high level.	Warning conditions: UV & IR at Warning level **(default)**.
6	Following a successful Manual BIT sequence: Alarm Relay is activated and the 4-20mA output turns to 20mA for approximately 3 seconds **(default)**.	Following a successful Manual BIT sequence (1),(2): Alarm Relay is not activated
7	Following a successful Manual BIT sequence (2): Accessory Relay is activated and the 4-20mA output turns to 16mA for approximately 3 seconds(3) **(default)**.	Following a successful Manual BIT sequence(2): Accessory Relay is not activated.
8	Accessory Relay used as EOL relay.	Accessory Relay function in accordance with the position of SW1-4 **(default).**

Notes:

1 The BIT sequence may last up to 7 seconds. Verify that all eight (8) switches are in the appropriate setting (ON/OFF), to achieve the required functional mode of operation.

2 SW1-2, SW1-6, SW1-7 are function only for model 20/20LB. Model 20/20L does include BIT.

3 If both SW1-6 and SW1-7 are at on position the 4-20mA output is 20mA (Alarm Level) after successful manual BIT.

Optional Latching (default is non-latching):
The detector includes a latched alarm output capability, which operates according to the DIP-switch SW1-1 position. Upon the detection of a fire, the detection signal is latched until manually reset (disconnecting the power supply or upon performing a manual BIT). Latching affects the Alarm Relay, 4-20mA output, Alarm LED, (the ACCESSORY RELAY will latch only when SW1-4 at OFF position).

Built-in Test Options (refer to 2.5):

Successful Manual BIT activates the following outputs according to SW1 switches:

SW1-6 ON:	The Alarm relay will be activated for 3 seconds. The 4-20mA output will provide 20mA for 3 seconds.
SW1-7 ON & SW1-6 ON:	The Accessory & Alarm relays will be activated for 3 seconds. The 4-20mA output will provide 20mA for 3 seconds.
SW1-7 ON & SW1-6 OFF:	The Alarm relay will be activated for 3 seconds. The 4-20mA output will provide 16mA for 3 seconds.
ACCESSORY RELAY AS EOL:	If SW1-8 is ON then the Accessory Relay is used as End of Line (EOL) relay. In this case the accessory relay is always active as long as the detector is powered.

4.3.2 Alarm Delay Switch (SW2)

The detector is equipped with different Alarm Delay options. It provides programmable time delays of 0 to 30 seconds with eight (8) fixed settings at: 0, 3, 5, 10, 15, 20, 25 and 30 seconds, using SW2 switches 1-3. See Table 5.
When an Alarm (Detection) level condition is encountered, the detector delays execution of the Alarm Relay and the 4-20mA output by the specified period of time. The detector will then evaluate the condition for required delay period. If the Alarm level is still present, the Alarm indications return to its standby state.

Table 5. SW2 Alarm Delay Setting

Delay	SW2 switches			
(seconds)	4	3	2	1
0	N/A	Off	Off	Off
3*	N/A	Off	Off	On
5	N/A	Off	On	Off
10	N/A	Off	On	On
15	N/A	On	Off	Off
20	N/A	On	Off	On
25	N/A	On	On	Off
30	N/A	On	On	On

** Default*

Note: The new FM approval from January 2003 does not allow use of 20, 25 and 30-second delay settings.

4.4 Detector States

The detector can be in one of the following states:

Normal: The detector is functioning.

BIT: The detector performs a BIT.

IR Detection: IR sensor is in Detection level.

UV Detection: UV sensor is in detection level.

Warning: The detector detects a fire and changes into its warning-pre-alarm state.

Alarm: The detector detects a fire and changes into fire alarm state.

Latched Alarm: The alarm outputs are latched after Alarm state due to the detection of a fire even when the fire has already been extinguished.

BIT Fault: A fault is detected during BIT sequence. The detector will continue to detect fire if the alarm conditions occur.

Fault: A fault is detected when the power supply is too low or during a software fault.

In each state the detector will activate different outputs as specified in Table 6.

Table 6. Output Signals Versus Detector State

Detector State	SW1	Yellow LED	Red LED	Alarm Relay	Accessory Relay	Fault Relay	4-20mA Output
Fault		2Hz	OFF	OFF	OFF	OFF	0mA
BIT Fault		2Hz	OFF	OFF	OFF	OFF	2mA
Normal		0.5HZ	OFF	OFF	OFF	ON	4mA
IR Detection only		0.5HZ	OFF	OFF	OFF	ON	8mA
UV Detection only		0.5HZ	OFF	OFF	OFF	ON	12mA
Warning	SW1-4 on	0.5Hz	2Hz	OFF	ON	ON	16mA
Alarm		0.5Hz	ON	ON	*	ON	20mA
Latch	SW1-1 on	0.5Hz	ON	ON	*	ON	20mA
Warning at BIT Fault		2Hz	2Hz	OFF	ON	OFF	16mA
Alarm at BIT Fault		2Hz	ON	ON	*	OFF	20mA

** Depends on SW1-4 set.*

The detector remains in Fault state until it passed a successful BIT. When SW1-4 is OFF, warning state is the same as the Alarm state. The alarm outputs are activated as long as the alarm conditions are present and stop approximately five seconds after the fire is no longer detected.

4.5 Built-In-Test (refer to 2.5)

a. Principles

The detector's Built In Test (BIT) checks the following:

- Electric circuitry
- Sensor
- Window cleanliness

The detector can be set to perform the BIT automatically and manually (SW1-2 = ON) or manually only (SW1-2 = OFF).

b. Principles

If the BIT succeeds, the detector's status turns to Normal.
If the BIT fails, a second BIT is executed after a delay of 6 seconds.
If the second BIT succeeds, the detector's status turns to Normal; otherwise the status is turned to Fault.

c. Manual BIT only (SW1-2= OFF):

The BIT is initiated manually by momentarily connecting terminal No. 3 with terminal No. 2.
A successful manual BIT activates the following:

- Fault Relay is closed.
- Alarm Relay is activated for 3 seconds (only if SW1-6 = ON).
- Accessory Relay is activated for 3 sec (only if SW1-7 = ON).
- 4-20mA Output current will be 20mA (only if SW1-6 = ON) or 16mA (Only if SW1-7 = ON and SW1-6 = OFF).
- The yellow LED blinks at 0.5Hz rate.

Unsuccessful BIT activates the following:

- Fault Relay is released.
- 4-20mA output indicates Fault condition (2mA).
- The yellow LED blink (at 2Hz rate)

Important Note!

If SW1 switches 7 or 6 are in their "ON" position the Alarm and Accessory Relays will be activated during a MANUAL BIT, therefore, automatic extinguishing systems or any external devices that may be activated during BIT must be disconnected.

d. Automatic & Manual BIT (only when SW1-2 = ON):

Manual BIT:
Functions as described in section 4.5.c.

In the case of an unsuccessful BIT, all outputs will function as described in section. 4.5.c., however, automatic BIT will be automatically executed every 1 minute.
This mode of operation continues until successful BIT have been encountered. As such result, the detector resumes its normal operation.

The Manual BIT performance initiates the DIPswitches configuration reading of the detector. This function is performed at any switch configuration even if manual BIT is disabled. This initiation is also performed at the 20/20L model, even though BIT does not exist.

Automatic BIT:

The detector automatically performs a BIT every 60 minutes.

A successful BIT does not activate any indication and the detector indicates normal as follows:

- The Fault Relay contacts are closed.
- The yellow LED blinks at 0.5Hz rate.

An unsuccessful BIT sequence the detector turns to Fault and activates the indications as follows:

- The Fault Relay contacts are opened.
- 4-20mA output indicates Fault (2mA).
- The yellow LED blinks at 2Hz rate.

BIT procedure is performed every one minute.

5. Technical Specifications

5.1 Electrical Specifications

a. Operating Voltage: 18-32 VDC

b. Power Consumption:
Max. 100mA in Stand-by
Max. 150mA in Alarm

c. Electric input protection:
The input circuit is protected against voltage reversed polarity voltage transients, surges and spikes according to MIL-STD-1275A.

d. Electrical Interface:

Terminals	Function
1	POWER SUPPLY IN (+)
2	RTN
3	MANUAL BIT
4	ALARM RELAY (NO)
5	ALARM RELAY (COMMON.)
6	ALARM RELAY (NC)
7	FAULT RELAY (NO)
8	FAULT RELAY (COMMON.)
9	ACCESSORY RELAY (NO)
10	ACCESSORY RELAY (COMMON)
11	4-20mA(-)
12	4-20mA(+)

e. Electrical Outputs:

- **Output Relays**:

Table 7. Dry Contacts Relays Ratings

Relay Name	Type	Normal position	Maximum Ratings
Alarm	SPDT	N.O. N.C.	2A at 30VDC or 0.5A at 250 VAC
Accessory	SPST	N.O.	5A at 30VDC or 250VAC
Fault	SPST	N.C.	5A at 30VDC or 250 VAC

- **4-20mA Current Output** stepped Levels at different detector states (on terminals 11 and 12):

Fault:	0mA	+0.5mA
Bit Fault:	2mA	±10%
Normal:	4mA	±5%
IR Detection:	8mA	±5%
UV Detection:	12mA	±5%
Warning:	16mA	±5%
Alarm:	20mA	±5%

  - The 4-20mA output is a current source type. The signal is driven via terminal 12 through the load to terminal 11 that should be at RTN level (when connected to terminal 2)
  - Maximum load permitted resistance for the 4-20mA is 600 ohm.

5.2 Mechanical Specifications

a. Enclosure:

Aluminum: Chromate coating and Epoxy enamel finish
or
Stainless Steel 316: Electrochemical passivation coating

b. Explosion Proof

FM approval	Class I Div. 1 Groups B, C and D;	
	Class II Div. 1 Groups E, F and G.	
ATEX	Ex II 2G SIRA 00ATEX 1160, 1162	
	EExd IIB + H_2	T5 Temp. -40°F (-40°C) to 160°F (70°C)
		T4 Temp: -40°F (-40°C) to 185°F (85°C)
		per EN 50014 & EN 50018
	EExde IIB + H_2	T5 Temp. -40°F (-40°C) to 160°F (70°C)
		per EN 50014, 50018 & 50019
		(see Appendix C)

c. Electrical Modules: Conformal coating.

d. Electrical connection:

Either: Two 3/4” - 14NPT conduits.
or: Two M25 x 1.5 cable entries

e. Dimensions:

Detector: 5.2 x 5.2 x4.7in (132 x 132 x 120 mm)

f. Weight:

Al. enclosure 3.7kg (8.1 lb.)
St.St. enclosure 6.5kg (14.3 lb)

5.3 Environmental Specifications

a. High Temperature:
Design to MIL-STD-810C, method 501.1 procedure II

Operating temperature:	+70 °C (+160 °F)
Optional operating temperature:	+85 °C (+185 °F)
Storage temperature:	+85 °C (+185 °F)

b. Low Temperature:
Design to MIL-STD-810C, method 502.1, procedure I

Operating temperature:	-40 °C (-40 °F)
Storage temperature:	-55 °C (-65 °F)

c. Humidity:
Designed to meet MIL-STD-810C, method 507.1, procedure IV
Relative humidity of up to 95% for the operational temperature range.

d. Salt and Fog:
Designed to meet MIL-STD-810C, method 509.1 procedure I.
Exposure to a 5% salt solution for 48 hours

e. Water and Dust:
IP66 & IP67 per EN 60529
NEMA 250 Type 6P

f. Shock and Vibration:
Vibration: Designed to meet MIL-STD-810C method 514.2, procedure 1.
Mechanical Shock: Designed to meet MIL-STD-810C method 516.1, procedure 1.

g. Electromagnetic Compatibility (EMC):
The detector is design and approved according to the following EMC requirements:

Electrostatic Discharge (ESD):	IEC801-2: 1984.
Conducted emission:	EN55022, Class A.
Radiated emission:	EN55022, Class A.
Radiated immunity:	IEC801-3: 1984.
EFT/B:	IEC801-4: 1988.

6. Installation Instructions

6.1 Introduction

This chapter does not attempt to cover all of the standard practices and codes of installation. Rather, it emphasizes specific points of consideration and provides some general rules for qualified personnel. Special safety precautions are stressed wherever applicable.

6.2 General Considerations

Very Important
The detector should be aimed toward the center of the detection zone and have a completely unobstructed view of the protected area.

- Whenever possible, the detector face should be tilted down at a slight angle to prevent the accumulation of dust and dirt.
- Do not start an installation unless all conceivable considerations regarding detector locations have been taken into account.
- To ensure optimal performance and an efficient installation, the following guidelines should be considered.

a. Spacing and Location

The number of detectors and their locations in the protected area are affected by the following:

- Size of the protected area.
- Sensitivity of the detectors.
- Obstructed lines of sight.
- Cone of view of the detectors.

b. Environment

Dust, snow, rain and oil can reduce the detector's sensitivity and require more maintenance activities.

6.3 Preparations For Installation

Installation should comply with NFPA 72E, as applicable to flame detectors. The detectors can be installed with the use of general-purpose common tools and equipment.

1 Verify the appropriate Purchase Order. Record the part number and Serial number of the detectors and the installation date in the appropriate Log-book.

2 Open the container package prior to detector installation and visually inspect the detector.

3 Verify that all components required for the detector installation are readily available before commencing the installation. In case that the installation is not completed in a single session, secure and seal detectors and conduits.

4 For wiring, use color coded conductors or suitable wire markings or labels. Wire diameter between 12 to 20 AWG (3.1 x to 0.5 mm^2) may be used for site wiring. The selection of wire gauge should be based on the number of detectors used on the same line and the distance from the control unit, in compliance with specifications (see Appendix A)

6.4 Conduit Installation

1 To avoid water condensation in the detector, it should be installed with the conduits placed downward, and should include drain holes.
2 When using the optional swivel mount, use flexible conduits for the last portion connecting to the detector.

3 For installations in atmospheres as defined in Group B of the NFPA, conduit inlets should be sealed.

4 When pulling the cables through the conduits, ensure that they are not tangled or stressed. Extend the cables about 12 in. (30 cm) beyond the detector location to accommodate wiring after installation.

5 After the conductor cables have been pulled through the conduits, perform a continuity test.

6.5 Detector Mounting

The detector may be mounted on a simple fabricated bracket, or preferably the optional Swivel Mount, Model No. 20/20-003. The Swivel Mount enables the detector to be rotated up to 40 degrees in all directions.

6.5.1 Swivel Mount Kit

Table 8: Mounting according to US Version

Item	QTY	Type /Model	Location
Swivel Mount	1	20/20-003	
Screw	4	1/4” -20UNC	Detector - Holding plate
1/4” Spring Washer	4	1/4”	Detector - Holding plate

Table 9: Mounting according to EU Version

Item	QTY	Type /Model	Location
Swivel Mount	1	20/20-003-1	
Screw	4	M6 x 1P	Detector - Holding plate
Spring Washer	4	M6	Detector - Holding plate

6.5.2 Swivel installation (Figure 4a and 4b)

1 Place the swivel mount (Item 6) in its designated location and secure it with four (4) M6 or 1/4” screws, placed 3.0 in. (76.2 mm.) apart on swivel mount plate (Item 10).

Note: Skip this step if the Swivel Mount is already installed. Also detector removal for maintenance purpose does not require Swivel Mount removal.

2 Unpack the detector carefully

3 Place the detector with its conduit inlets pointing down on the holding plate of the Swivel Mount (Item 7). Secure the detector to the Swivel Mount by four (4) 1/4”-20UNC screws or M6 x 1P (Item 9) with 1/4” (M6) spring washers enclosed with the Swivel Mount Kit.
Use 3/16 Hex Key for 1/4” screws or No. 5 Hex Key for M6 screws.

4 Tighten the three locking 3/8"-24UNF screws (item 8) of the swivel mount ring until the friction in the ball joint holds the detector in its position, maintaining the ability to be moved by hand-applied force (Use 3/16" HEX KEY).

5 Point the detector towards the protected area and make certain that the view of the area is not obstructed. Secure the detector in that position by tightening the locking screws of the swivel mount ring.

The detector is now correctly located and aligned, and ready for connecting to the system.

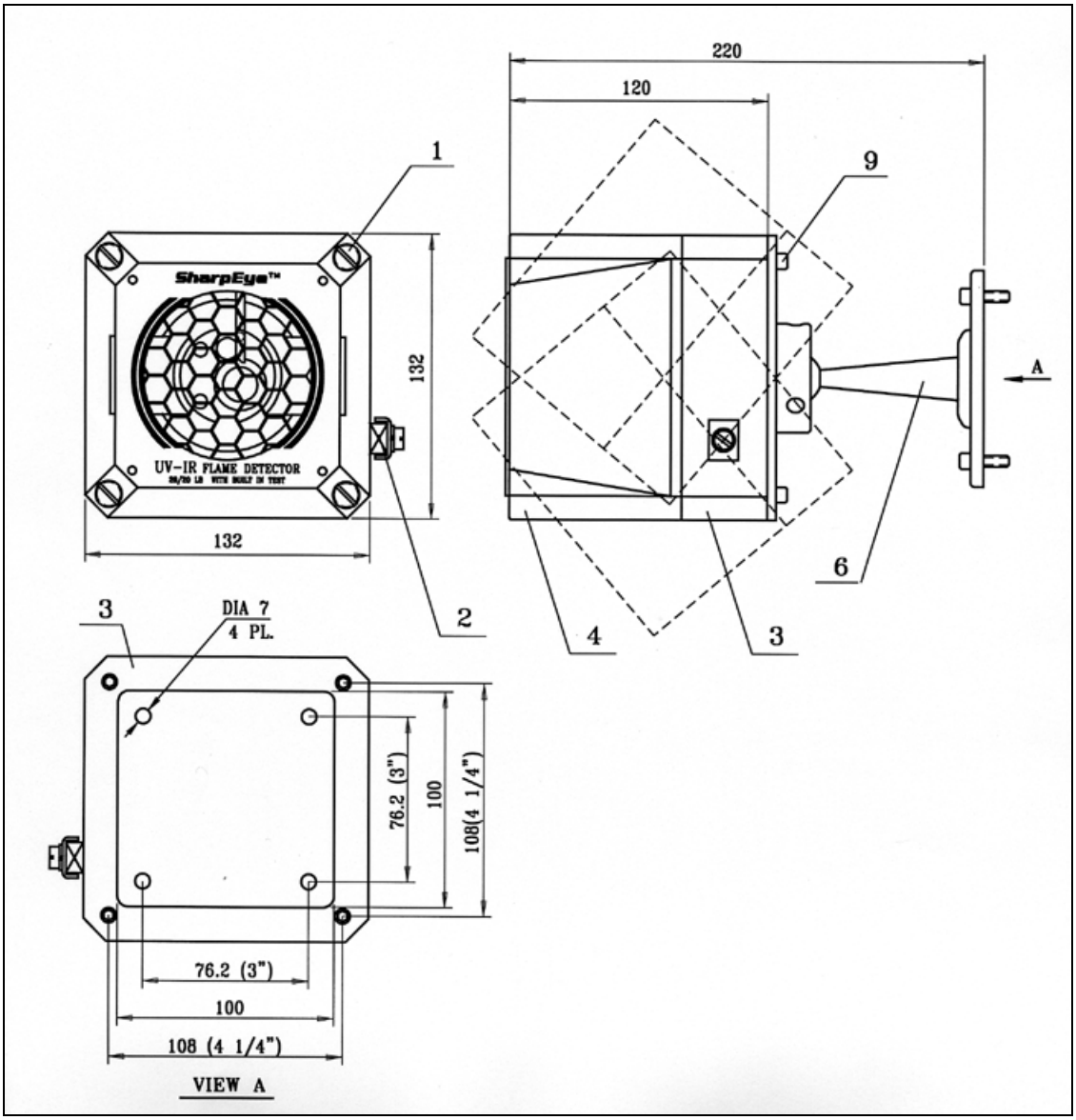
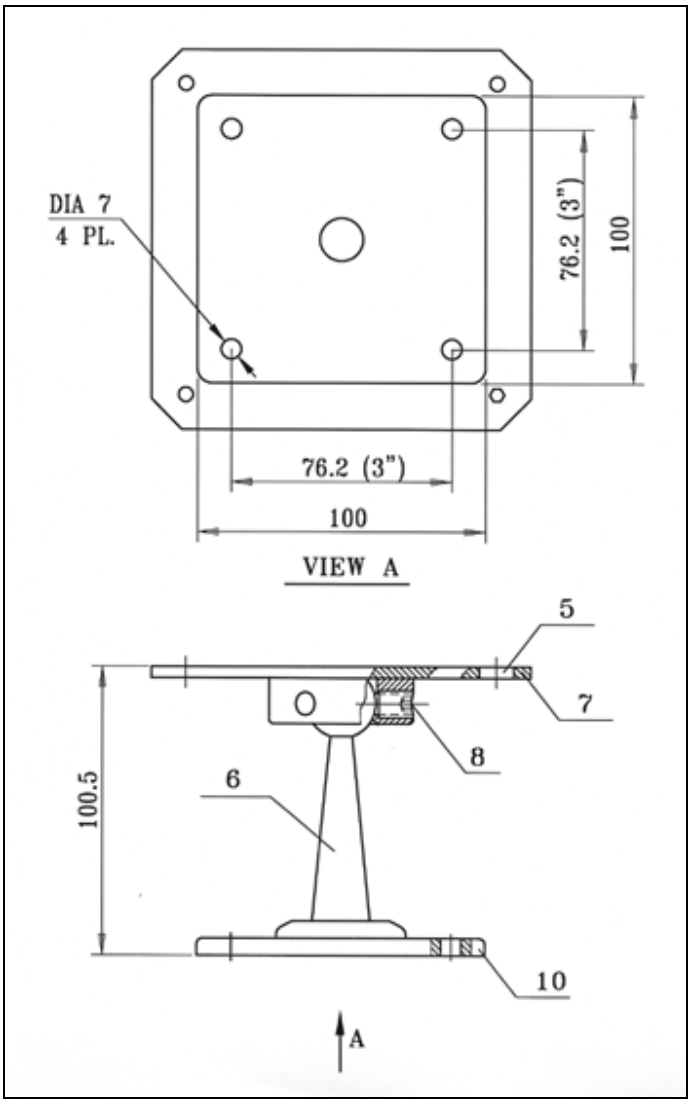


Figure 4.a. U/IR Detector and Swivel Mount Assembly



Description	
1	Protective Set Screws
2	Ground Terminal (for ATEX) or Ground Thread (for FM)
3	Back Cover
4	Housing
5	Swivel Mount Screw Hole
6	Swivel Mount
7	Holding Plate
8	Locking Screws
9	Detector Mounting Screws
10	Swivel Mount Plate
11	Swivel mounting screws

Figure 4.b. Swivel Mount Assembly

6.6 Wiring (Refer to Fig. 5)

1 Disconnect power.
2 Remove the four protective set-screws (Fig 4a, item 1) from detector front.

3 Release the four socket-head screws that secure the detector housing (Item 3) to its back cover (Item 6) using No. 5 Hex Key for M6 screw. Hold the housing during the removal of the screws. With the screws removed, pull the detector housing from its cover. The cover remains attached to the detector swivel mount. The housing slides under the cover and remains attached to it by a securing cable (Item 8). The terminal board (Item 7) inside the detector cover is now revealed.

4 Remove the protective plug mounted on the detector conduit inlet (Item 10). Pull the wires through the detector cover (Item 6) and secure them firmly to the cover using the cable-tie (Item 11) attached to it. Use a 3/4”-14NPT or M25 x 1.5P explosion-proof conduit/cable gland connection.

5 Connect the wires to the required terminals (Item 7) according to the wiring diagram. See section 6.7 and figures 6 and 7.

6 Connect a Grounding Cable to the Ground Terminal (Item 4) outside the detector cover (Item 6). For FM installation connect the Grounding Cable to the Ground Thread (Item 4) using appropriate screw.

The detector must be well grounded to *Earth Ground* for proper operation.

7 Verify the wiring. Improper wiring may damage the detector.

8 Check the wires for secure mechanical connection and press them neatly against the Terminal Board (Item 7) to prevent them from interfering while closing the detector’s housing.

6.7 Terminal Wiring (Figures 6,7)

The detector contains a terminal board consisting of two terminal blocks.
The left terminal block is labeled 1 to 6; the right terminal block is labeled 7 to 12.
See Figure 6.

The following describes the function of each electrical terminal of the detectors.

Power Supply: (Terminals 1, 2)
Input power is supplied to terminal No. 1.
The RETURN is connected to terminal No.2.

Manual Bit Activation: (Terminal 3)
Terminal No. 3 is used for the manual BIT activation. The manual BIT is initiated by a momentary connection of Terminal No. 3 to the power supply return line.

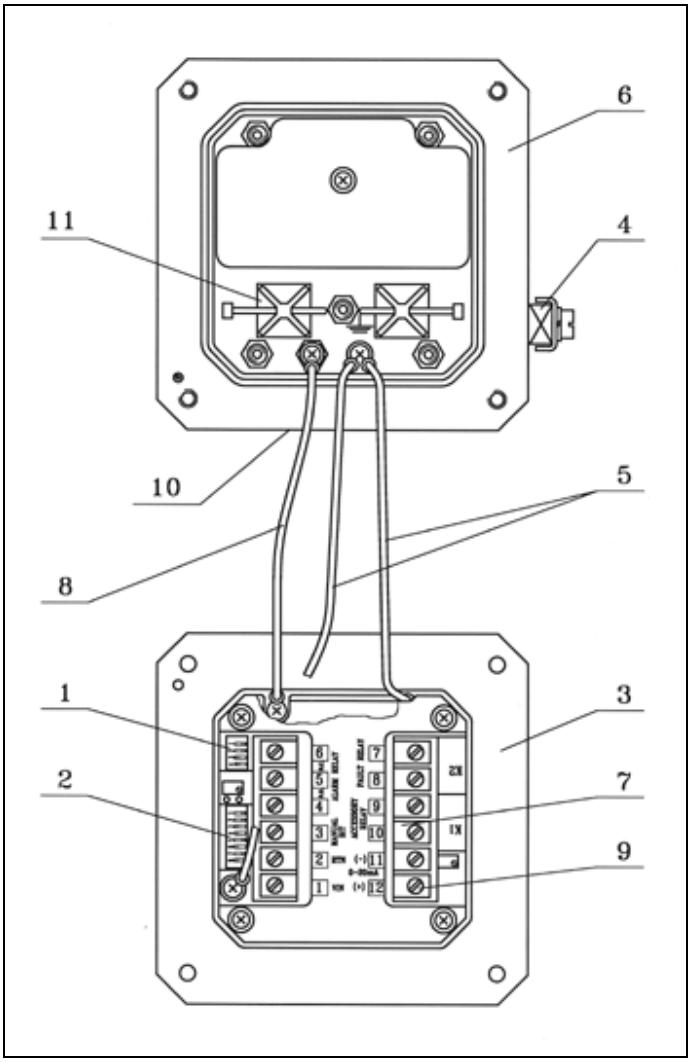
Alarm Relay: (Terminals 4, 5, 6)
The Alarm output is a change over contact relay (SPDT)
Terminal No. 4 is the NO relay contact
Terminal No. 5 is the COMMON relate contact
Terminal No. 6 is the NC relay contact

Fault Relay: (Terminals 7, 8)
The Fault output in NC SPST contact at terminals no. 7 and 8. The contacts are closed when the detector is in its normal operational condition

Accessory Relay: (Terminals 9, 10)
The Accessory output is N.O. SPST relay at terminals no. 9 and 10. The Accessory relay may act in parallel with the Alarm relay to activate another external device or it may provide a warning signal, depending on the position of SW1-4.

Note
To protect the dry contacts from voltage surges when connected to reactive loads (electric motors, sirens, etc.) connect an appropriate varistor over these contacts.

4-20mA Output: (Terminals11, 12)
As specified in section 5.1.e.
Terminal 11 is used as RETURN terminal (-) (RTN)
Terminal 12 is used as output terminal (+)
See appendix B for more details.



Legend:	
1	Alarm Delay Switch (SW2)
2	Function Switch (SW1)
3	Housing
4	Earth (Ground) Terminal (for ATEX) or Earth Thread (for FM)
5	Grounding Wires
6	Back Cover
7	Terminal Board
8	Securing Cable
9	Terminal Screws
10	Conduit Inlet
11	Cable Tie

Figure 5. UV/IR Flame Detector with Cover Removed

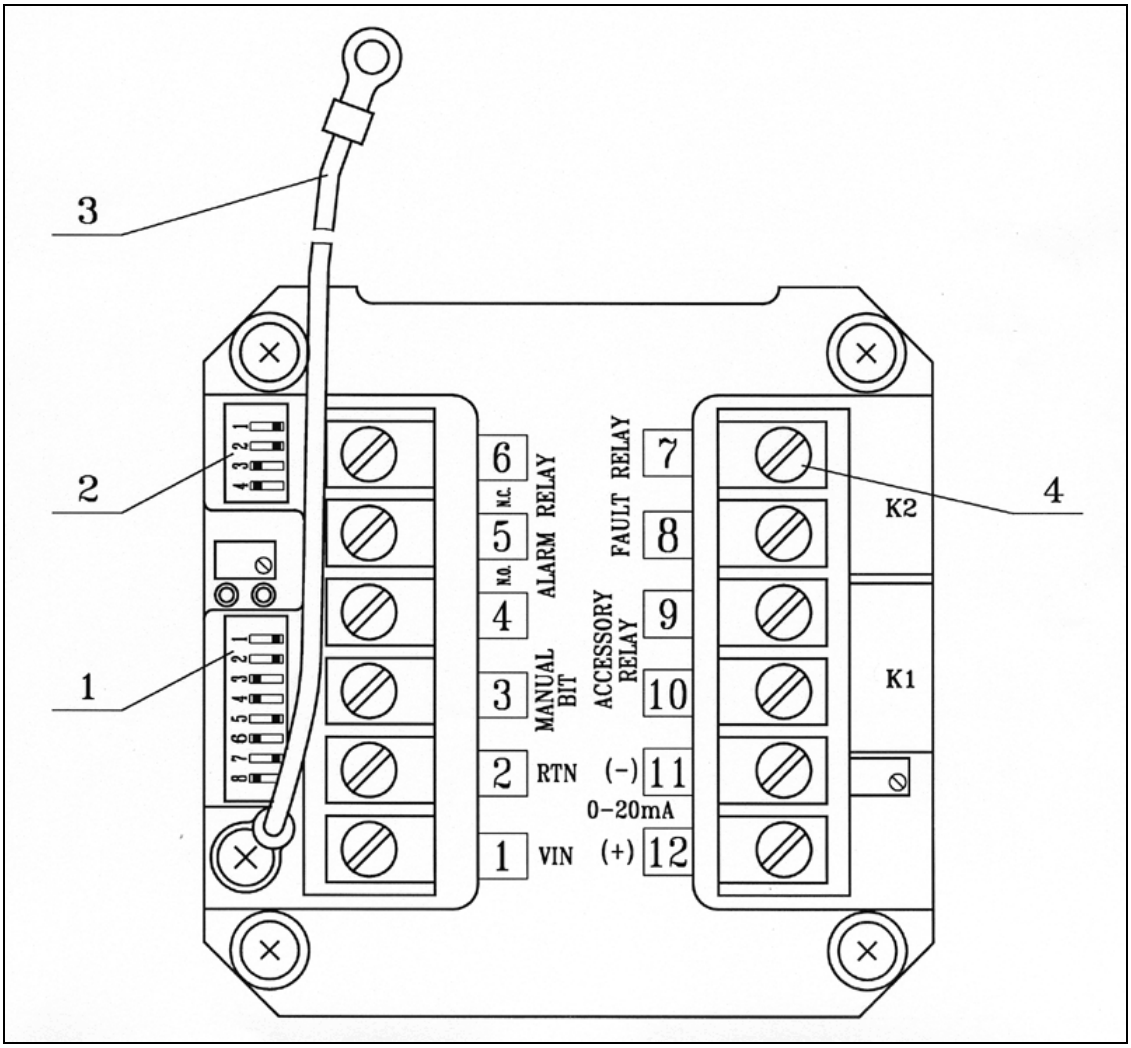


Figure 6. Terminal Board Configuration

Legend:
1. Function Switch (SW1)
2. Alarm Delay Switch (SW2)
3. Ground Cable
4. Terminal Screws

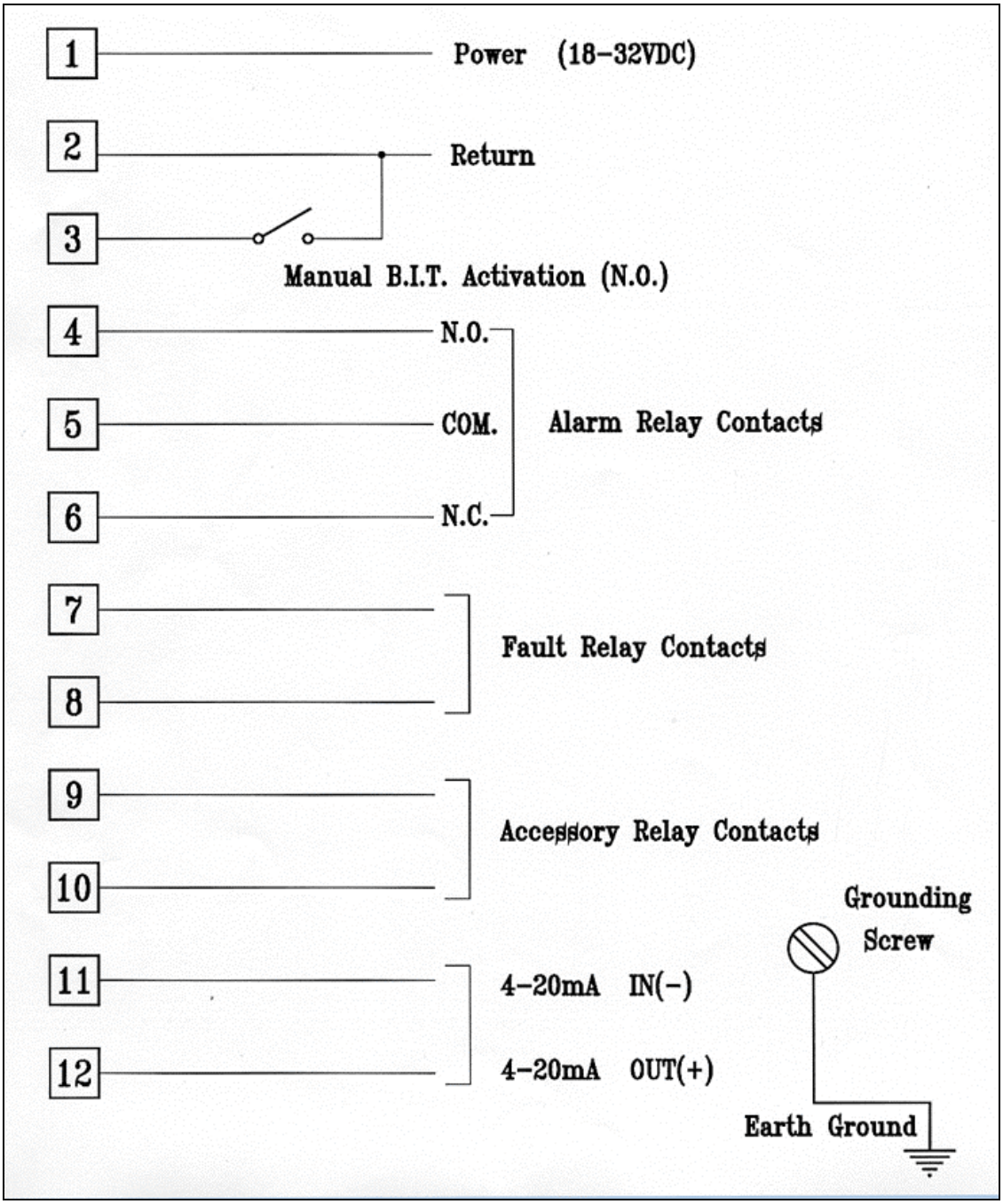


Figure 7. Flame Detector Assembly - Wiring Diagram

6.8 Selection Of Operating Modes

When wiring is completed the operational mode can be selected.

Mode selection is achieved by means of two DIPswitches listed below:
SW1 - Function switch
SW2 - Alarm Delay switch

Function switch (SW1)
Modes of operation are selected by DIPswitch (SW1) according to the selection table (Table 4 at section 4.3.1).

Alarm Delay Switch (SW2)
An Alarm Delay may be required for certain applications. The detector has an Alarm Delay switch (SW2), permitting time delays from 0, 3, 5, 10, 15, 20, 25 and 30 seconds respectively (see table 5).

1 Setting Function Switch (SW1): Set all eight (8) switches of SW1 to their appropriate settings (ON/OFF), to achieve the required functional mode. See Table 4 at section 4.3.1.

2 Setting Alarm Signal Delay Switch (SW2): Set SW2 to the appropriate position to achieve the required time delay. See Table 5 at section 4.3.2.

3 Verify that the “O” Ring is in its groove in appropriate position on the back cover.
- Close the detector
- Connect the housing to the cover using the alignment pin on the back cover.
- Tighten the four (4) socket-head screws to secure the detector housing to its back cover (tightening torque 1 Kg * M).

4 Install the four (4) set-screws that protect the socket-head screws.

The Detector is now wired, assembled as its operational mode properly set.

7. Operating Instructions

7.1 Scope

The following instructions are designed to obtain optimal performance from the detector over its life-cycle.

7.2 Power-Up

1 Apply power and wait up to 40 seconds for the automatic self-test of the detector.

Note:
Applying power initiates the following sequence:
- The yellow LED blink (2 Hz)
- BIT is executed.

If successful then:
- The yellow LED blink (0.5 Hz)
- Fault Relay contacts close

2 Wiring inspection. If a short-circuit or line discontinuity exists, indications will appear on the control unit display panel. Review your wiring.

3 The detector goes into its FAULT state when supply voltage drops under 16.5V. The detector status goes back to NORMAL when the supply voltage is above 17.5V.

4 Detector inspection: Visually inspect the viewing window of the detector. It should be clean and clear. The yellow LED should blink (0.5Hz) and the Alarm and Accessory Relays should be off and the Fault Relay should be on.

5 If any of the outputs or indications is different from the description in step 3, see section 8.6 for troubleshooting.

7.3 Reset

To reset a detector when in Alarm Latch state, turn OFF power supply for 10 sec., or initiate a manual BIT.

7.4 Functional Testing

Following is a testing procedure for proper wiring and functioning of the detector.

Important Note!
If SW1 switches 7 or 6 are in their "ON" position the Alarm, Accessory Relays and 4-20mA will be activated during a MANUAL BIT, therefore, automatic extinguishing systems or any external devices that may be activated during BIT must be disconnected.

1. Verify that the detector is operated properly.

2. Initiate manual BIT. After a few seconds the following occurs:
   - Alarm Relay will be activated for 3 seconds (Only if SW1-6 is ON).
   - Accessory Relay will be activated for 3 seconds (Only if SW1-7 is ON).
   - The LED should blink at 0.5Hz rate.
   - Fault Relay will stay active during the test.

This completes the installation procedure. The detector and system are now ready for operation.

7.5 Testing With Fire Simulator (See Appendix D)

This test is producing to simulate an exposure of the detector to a real fire condition. The detector is exposed to the radiation in the specified detection level. As a result, the detector must generate a Fire Alarm signal

Important Note!
If the detector is exposed to a fire simulator the Alarm, Accessory Relays and 4-20mA will be activated during the simulation. Therefore, automatic extinguishing systems or any external devices that may be activated during this process must be disconnected.

1 Apply power to the system and wait up to 40 seconds for turning of the detector to normal state. The yellow LED should blink at 0.5Hz rate. If the detector is ON, skip this step.

2 Aim the Spectrex Fire Simulator Model 20/20-311 to the target point of the detector (see Fig. 14), in a way that the radiation emitted by it is facing directly towards the detector (See Appendix D.)

3 Press the operation button once. After few seconds the red LED should be on for few seconds. After this period the red LED should be off and the yellow LED blink continually at 0.5Hz rate. The 4-20mA output should turn to 20mA for few seconds and then to return to 4mA. The Alarm Relay should also turn on to this period. The Accessory Relay should respond in parallel to the Alarm Relay if SW1-4 is OFF.

7.6 Safety Precautions

After powering-up, the detector requires minimal attention in order to function properly, but the following should be noted

1 Follow the instructions in the manual and refer to the drawings and specifications issued by the manufacturer.

2 Do not expose the detector to radiation of any kind unless required for testing purposes.

3 Do not open the detector housing, while power is supplied.

4 Do not touch internal parts other than the two functional switches. Interference with internal circuits may impair detector performance and will invalidate manufacturers warranty.

5 Disconnect external devices, such as automatic extinguishing systems before carrying our any maintenance task.

8. Maintenance Instructions

8.1 Scope

This chapter deals with preventive maintenance, describes possible faults in detector operation and indicates corrective measures. Ignoring these instructions may cause problems with the detector and any invalidate the warranty.

Whenever a unit requires service, please contact the manufacturer or its authorized distributor for assistance.

8.2 Maintenance Instrumentation And Personnel

The detector's maintenance requires ordinary tools and qualified personnel, which should be familiar with local codes and practices

8.3 Preventive Maintenance Procedures

The detector must be kept as clean as possible. The viewing window and the reflector of the model 20/20L, 20/2LB Flame Detector must be cleaned on a periodic basis. The frequency of cleaning operations depends upon the environmental conditions and specific applications. The fire detection system designer will give his recommendations. Use of the optional AIR SHIELD Model 20/20-930 is highly recommended and will help to keep the window clean and prevent dirt from accumulating on the window.

1 Disconnect power to the detector before proceeding with any maintenance.

2 To clean the detector-viewing window and reflector use water and detergent then rinse with clean water.

3 Where dust, dirt or moisture accumulates on the window, first clean with a small soft brush under the window guard, then clean with a soft optical cloth and detergent and finally rinse with clean water. Do not attempt to open the window guard since it should not be removed.

8.4 Periodic Maintenance Procedures

In addition to preventive cleaning and maintenance, the detector should be functionally tested every six months. The test should also be carried out for any reason the detector has been opened.

8.4.1 Power Up Procedure

Perform Power-Up procedure every time power is restored to the system. Follow the instructions in section 7.2.

8.4.2 Functional Test Procedure

Perform a functional test of the detector as described in section 7.4 and 7.5.

8.5 Maintenance Records

It is recommended to record maintenance operations performed on a detector in the System Log Book. The record should include information, which identifies the unit, installation date, contractor, and entries for every maintenance operation performed including the description of the operation, date and personnel ID.
If a unit is sent to the manufacturer or distributor for service, a copy of the Maintenance records should accompany it.

8.6 Troubleshooting

8.6.1 Fault Indication

The following subsections describe possible faults and suggestion for immediate solutions.

1 Check power supply for correct voltage, polarity and wiring.

2 Check detector window and reflector for cleanness. If necessary clean the window as indicated in section 8.3 and repeat the test.

3 Disconnect the power supply from the system and check the detectors' internal wiring.

4 Re-connect powers supply and wait approximately one minute. Repeat the test. If any indication LED is still blinking at 2Hz rate, the unit is faulty and requires to be removed and to be submitted for repair.

8.6.2 False Alarm or Warning Indication

1 Disconnect the power supply from the system and check the detector's internal wiring.

2 Re-connect powers supply and wait approximately one minute. Repeat the test. If the indication LED is still blinking at 2Hz rate, the unit is faulty and requires to be removed and to be submitted for repair.

Appendix A - Wire Selection Tables

GENERAL INSTRUCTION FOR ELECTRICAL WIRING:

1. Refer to Table 10 to determine the required wire gauge for general wiring, such as relay wiring. Calculate the permitted voltage fall with respect to loads current, wire gauge, length of wires.
2. Refer to Table 11 to select wire gauge for detectors power supply wires. DO NOT connect any device or load to detectors supply inputs.

Table 10. Maximum DC resistance at 68°F for copper wire

AWG	mm^2	Ohm per 100 ft.	Ohm per 100 meter
26	0.12 - 0.15	4.32	14.15
24	0.16 - 0.24	3.42	11.22
22	0.30 - 0.38	1.71	5.60
20	0.51 - 0.61	1.07	3.50
18	0.81 - 0.96	0.67	2.20
16	1.22 - 1.43	0.43	1.40
14	1.94 - 2.28	0.27	0.88
12	3.09 - 3.40	0.17	0.55
10	4.56 - 6.64	0.11	0.35

Wiring Gauge

1 Select “No. of detectors” connected on one circuit.
2 Select “wiring length” per your installation requirements.
3 Refer to “Power Supply Range” for voltage extreme applied.

Table 11. Wiring length in feet (meter)

No. of Detectors	Recommended Wire Diameter					Power Supply Range (VDC)
24	18	16	14	-	-	22-32
20	18	16	14	-	-	22-32
16	20	18	16	14	-	22-32
12	20	18	16	14	-	20-32
8	20	18	16	14	-	20-32
4 and less	20	18	16	16	14	20-32
Feet (meter)	164 (50)	328 (100)	492 (150)	656 (200)	820 (250)	
	Max. Length from Power Supply to Last Detector					

Appendix B. Typical Wiring Configurations

Wiring for Four Wire Controllers:

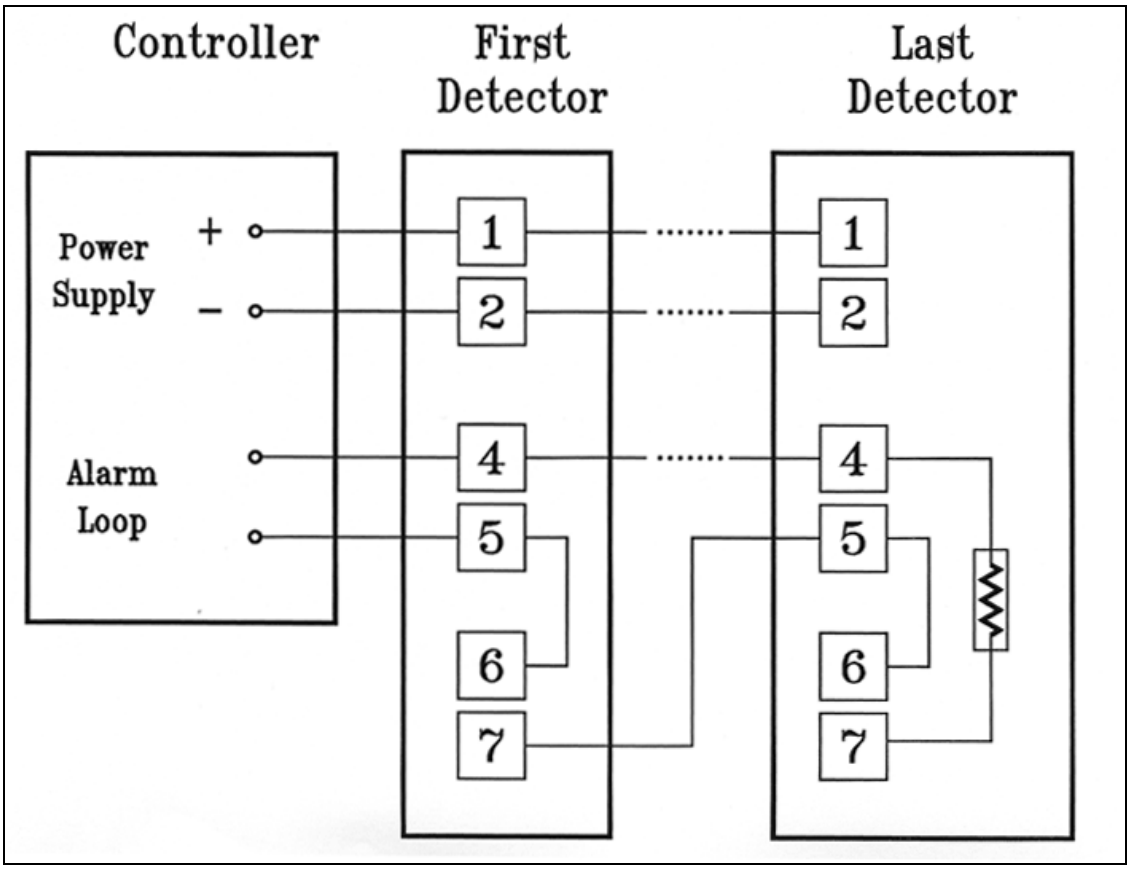


Figure 8. Typical Wiring Diagram for Four-Wire Controller

4-20mA Interface Wiring:

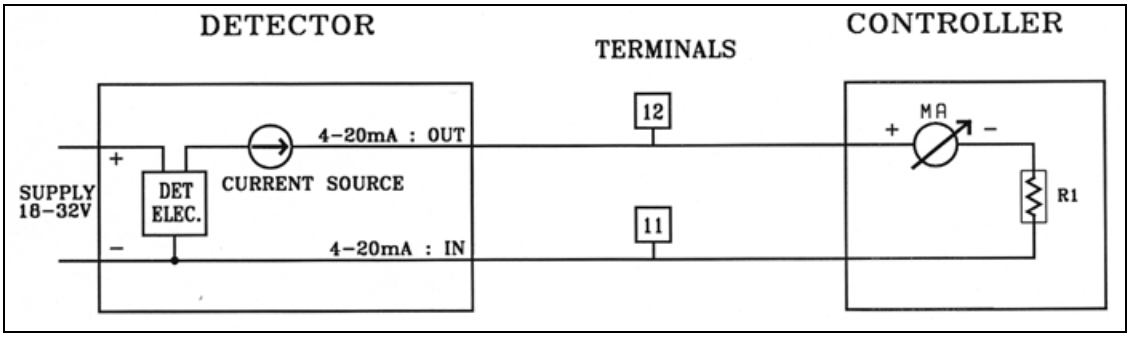


Figure 9. Wiring Diagram for 4-20mA

Appendix C. Mounting the “EExde approved” version

The EExde approved version provides an additional EExe terminal box attached below the EExd detector and therefore allows easier access in hazardous areas (see fig. 10). The unit is prewired to the terminals in the additional EExe terminal section ready for field wiring connections

1. Detector Mounting
The detector may be mounted on a simple fabricated bracket, or preferably the optional Swivel Mount, Model 20/20-003. The Swivel Mount enables the detector to be rotated up to 40 degrees in all directions.

1.1 Swivel Mount Kit
Use the kit from the paragraph 6.5.1

1.2 Swivel installation

1 **Refer to Fig. 4a and Fig. 4b** Place the swivel mount (item 6) in its designated location and secure it with four (4) M6 or 1/4" screws (item 11), placed 76.2 mm. (3.0 in.) apart on the swivel mount plate (item 10).

Note: Skip this step if the Swivel Mount is already installed. Also detector removal for maintenance purpose does not require Swivel Mount removal.

2 Unpack the detector.

3 Place the detector, with its conduit inlets pointing down, on the holding plate of the swivel mount (Fig. 4b item 7). Secure the detector by four (4) M6 screws with M6 spring washers from the Swivel Mount Kit using the holes (Fig. 4a item 9). You can use the thread on the modified cover (Fig. 10 item 1) marked either triangle symbol (∆) or square symbol (⍓). Use No. 5 Hex Key for M6 screws.

4 Tighten the three locking 3/8"-24UNF screws (Fig. 4b item 8) of the swivel mount ring until the friction in the ball joint holds the detector in its position. Yet, still permits it to be moved by hand-applied force (Use No.5 Hex Key).

5 Point the detector towards the protected area and make certain that the view of the area. Secure the detector in that position by tightening the locking screws (Fig.4b item 8) of the swivel mount ring.

The detector is now correctly located and aligned and ready for connecting to the system.

2. Wiring

Refer to Fig. 10.

1 Disconnect power.

2 Release the four (4) slotted-head screws (Item 3) that secure the chamber cover (Item 2). The chamber is now revealed.

3 Remove the protective plug mounted on the detector conduit inlet, pull the wires through the detector chamber (Item 7). Use M25x1.5 explosion-proof conduit connection to assemble the conduit to the detector.

4 Connect the wires to the required terminals (Item 4) according to the wiring diagram. See paragraph 2.1 and figures no. 11 and no. 12.

5 Connect the grounding wire to the ground screw outside the detector cover (Item 5).

The detector must be well grounded to *Earth Ground* for proper operation.

6 Verify the wiring. Improper wiring may damage the detector.

7 Check the wires for secure mechanical connection and press them neatly against the terminal to prevent them from interfering while closing the cover (Item 2).

8 Place and secure the cover chamber (Item 2) using four (4) slotted-head screws (Item 3).

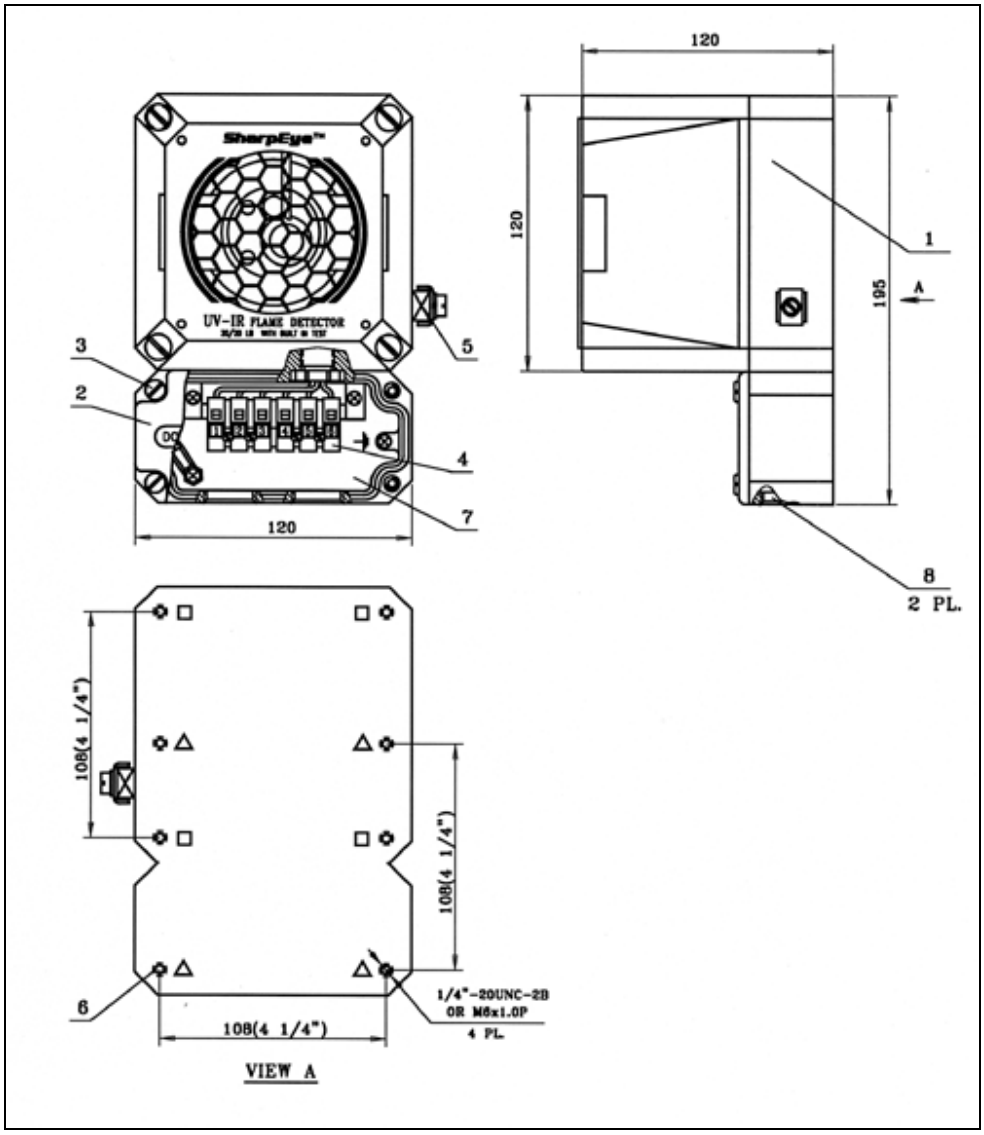


Figure 10: Flame Detector Assembly - Wiring Diagram

Description			
1	Modified Back Cover	5	Ground Terminal
2	Chamber Cover	6	Mounting Thread
3	Slotted Screw	7	Chamber
4	Terminal Block	8	Conduit Inlet (M25 x 1.5)

2.1 Terminal Wiring

The detector contains a chamber consisting of a terminal block (Item 4). The terminal block is labeled 1 to 6. (**See Fig. No.10**.)

Table 12. Terminals wiring options of the detector

Alarm Relay & 4-20mA Version Option A (See Fig. No. 11)	Alarm & Fault Relays Version Option B (See Fig. No. 12)
Power Supply (Terminal Numbers 1, 2):Input power is supplied to Terminal No. 1.RETURN is connected to Terminal No. 2.	**Power Supply** (Terminal Numbers 1, 2):Input power is supplied to Terminal No. 1.RETURN is connected to Terminal No. 2.
Alarm Relay (Terminal Numbers 3, 4): The Alarm output is a NO. SPST contact at Terminal Numbers 3 and 4. The contacts are closed at Alarm Mode.	**Alarm Relay** (Terminal Numbers 3, 4): The Alarm output is a NO. SPST contact at Terminal Numbers 3 and 4. The contacts are closed at Alarm Mode.
4-20mA Output (Terminal Numbers 5, 6): Terminal Numbers 5 and 6 are used for analog, 4-20mA current output as specified in paragraph 4.e Terminal No. 5 is used as output Terminal. Terminal No. 6 is used as input Terminal. see appendix B for more details)	**Fault Relay** (Terminal Numbers 5, 6): The Fault output is NC. SPST contact at Terminal Numbers 5 and 6. The contacts are open at Fault condition.

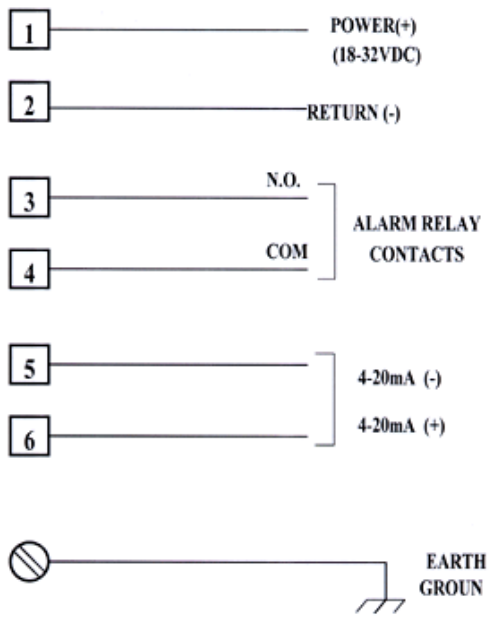
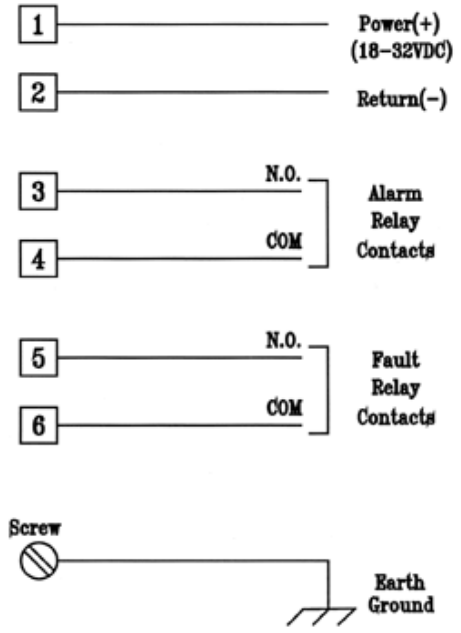

	

Figure 11: OPTION A Flame Detector Assembly - Wiring Diagram (“de version”)	***Figure 12: OPTION B Flame Detector Assembly - Wiring Diagram (“de version”)***

Appendix D. Long Range UV/IR Fire Simulator

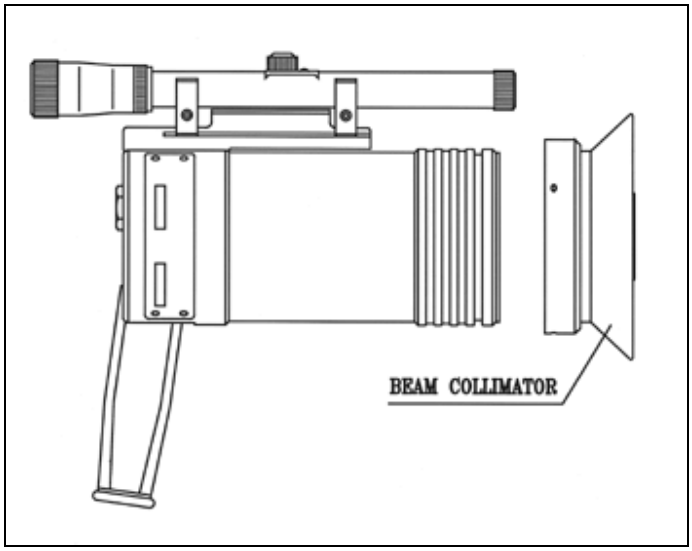


Figure 13: Fire Simulator

Product Description

The SharpEye UV/IR Long-Range Fire simulator 20/20-311 is designed specifically for use with the UV/IR or UV flame detectors. The Fire Simulator emits UV/IR radiation in a unique sequential pattern corresponding and recognizable by the detector as fire. This allows the detectors to be tested under real fire conditions without the associated risks of an open flame. There is a specially designed beam collimator (model number 20/20-190) used for extended range.

Unpacking

In addition to the delivery form, there should be the following contents:

- Fire Simulator with built in batteries
- Battery charger
- Optional Beam Collimator
- Storage case

Operating Instructions

Warning: Do not open the Fire Simulator to charge the batteries or for any other reason in a hazardous area.

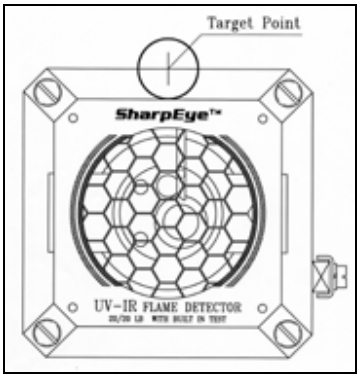


Figure 14: UV/IR Detector Target Point

Caution:

1 The following test will simulate a real fire condition and may activate the extinguishing system or other alarms. If this is not desired, disconnect them before the test and reconnect after the simulation.

2 Please note that if your flame detector mode is in “High UV protection enabled” - switch SW-3 ON, a beam collimator should be used.

Follow these instructions to simulate a fire:

1 Aim the Fire Simulator towards the detector’s “Target Point” (see Fig. 14)

2 For testing, keep a distance of at least 20 inches (50cm) from the detector.

3 Press the operation button once. Fire simulation will last for 20 seconds. The detector will send an alarm signal.

4 For another fire simulation a 20 second time lapse is required between tests.

5 Make sure the optical window is clean and keep the Fire Simulator in the storage case when not in use.

Battery Charging

1 The Fire Simulator uses NiCd batteries as a rechargeable power source. When the batteries are fully charged it will operate for at least 60 uses without recharging. An internal buzzer is sounded when the voltage from the batteries is lower than the required operational level.

2 Place the Fire Simulator into the storage case on a table in a safe area.

3 Turn the sealed plug (next to the operation button) counter clockwise with a suitable wrench.

4 Connect the battery charger.

5 Charge for a maximum of 14 hours.

6 Disconnect the charger.

7 Tighten the sealed plug clockwise.

Specifications

Mechanical		
Explosion Proof Enclosure: NFPA (designed to meet) Class I, Division 1 & 2 Groups B, C and D Class II, Division 1 & 2 Groups E, F, and G ATEX EX II2G NEMKO 02ATEX255 EExd IIB T5 50˚C per En 50-014 & EN50-018		
Electrical		
Power:	8 VDC Max 6 x Rechargeable1.2 VDC NiCd Batteries	
Current:	2.5A Avg.	
Charge:	400mA for 14 Hours	
Environmental		
Temperature Range:	-4º F (-20º C) to 122º F (50º C)	
Vibration Protection:	1g (10-50hz)	
Water and Dust:	IP 67 per EN 60529	
Physical		
Dimension:	11.5 x 10.1 x 3.9 in (292 x 258 x 100 mm)	
Weight:	7.5 lb. (3.4 Kg)	
Range*		
Model	**Standard**	**Extended Range**
20/20L	14.5 ft (4.5m)	29 ft (9 m)
20/20U	14.5 ft (4.5m)	29 ft (9 m)
20/20LB	14.5 ft (4.5m)	29 ft (9 m)
20/20UB	14.5 ft (4.5m)	29 ft (9 m)
20/20F	2.4 ft (0.75m)	-

* The minimum distance from the detector is 20 inches (50cm)
* At extreme temperatures 15% Max. Reduction

Technical Support

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